CHAPTER 4

RESULTS AND DISCUSSION

The soil loss results and the versions applied by the selected prediction models and field assessment method were used to evaluate their suitability for use as erosion evaluation tools in the monitoring and evaluation process of LandCare projects. The results of the evaluation study were used to conclude which of the ACED method or SLEMSA and RUSLE prediction models are best suited for decision-making and as a learning tool.

Soil loss results emanating from ACED cannot be compared with that of SLEMSA and RUSLE since the approaches used are different. For instance, ACED can only evaluate the amount of soils loss due to current visible damage and is expressed in t/ha. Whereas, with SLEMSA and RUSLE it is possible to make predictions on soil loss rates based on important parameters over a particular period and are expressed as t/ha/yr. As a result, only the predicted soil loss rates by SLEMSA and RUSLE were compared and separately from the amount of soil loss results determined by ACED.

In the case of SLEMSA, the soil loss results of both the original and modified (Hudson, 1987; Schulze, 1979) versions are presented in the tables. However, only soil losses by Hudson and Schulze's version have been used for the evaluation purpose, as they were considered realistic as explained in the materials and methods.

4.1. PREDICTION OF CURRENT CONDITIONS

The predicted and measured soil loss results for the four selected hillslopes are presented in Table 4.1 – 4.4 according to various land facets. The predicted soil loss rates in Table 4.1 – 4.4 by SLEMSA and RUSLE could not be summed, as the results are not based on the area size of the land facets. The soil loss rates based on the sizes of the land facets for SLEMSA and RUSLE are presented in Appendix 3.

4.1.1 Hillslope 1

Hillslope 1 is a rangeland utilised for communal grazing and has long and steep slope gradients and shallow medium textured soils of Mispah and Glenrosa forms on the upper slopes with Hutton and Clovelly forms at the bottom of the hillslope (Figure 3.3). Shallow and deep rills were present on the upper slopes on the rock outcrop area, whereas gullies influenced the lower bottom of the hillslope. According to Haarhoff *et al* (1994) the shallow medium textured soils on the upper slopes have very low permeability and high runoff potential (Appendix 3, Table 1).

Table 4.1. Soil loss as predicted by SLEMSA and RUSLE and measured by ACED for the land facets of hillslope 1

Land facet no.	**Field Size** (m^2)	**ACED** (t/ha)		**SLEMSA** (t/ha/yr)		**RUSLE** (t/ha/yr)
		Rills and gullies	Rills only	Elwell and Stocking (1973) approach	Schulze (1979) and Hudson (1980) approach	
1	544	2.7	2.7	81.7	12.1	9.0
2	440	9.5	9.5	29.1	4.3	5.7
3	520	12.1	12.1	37.3	5.5	9.9
4	660	39.2	39.2	70.3	10.4	17.2
5	1144	1.3	1.3	31.5	4.7	10.6
6	1748	20.6	20.6	23.7	2.9	6.8
7	4860	6.2	6.2	351.7	124.2	18.7
8	2856	586.7	112.2	16.5	1.59	24.2
9	3770	6,136.7	2.2	22.9	2.2	24.2
10	960	183.8	0.0	2.1	0.2	0.7
Total	**17,502**	**6,998.8**	**680.6**	-	-	-

The steep slopes of the rangeland were poorly vegetated (Appendix 3, Table 2 and Appendix 5, Plate 3; 4 and 5), and are generally susceptible to geologic erosion that can be worsened by agricultural activities of frequent animal trampling, overgrazing and footpaths. Soil losses on Table 4.1 were obtained from soil loss calculation tables of Appendix 5, hillslope 1.

According to Table 4.1, ACED indicates that soil loss on the hillslope results from damage by gullies and rills. Although, gullies were less frequent than rills and occupy a small area, they caused a severe damage and contributed excessive soil loss on the hillslope. The amount of soil loss without contribution of gullies could have been only 680.6 as compared to 6998.8 t/ha with gullies. That is, soil loss from rill erosion damage is approximately 10 fold less without the influence of gullies. The critical damage and the incision of gullies occurred downslope at land facet 9 and 10 (Table 4.1). Morgan (1995) indicated that as the slope length increases surface runoff volume concentrates and the rate of detachment and gully incision increases.

Land facet 10 is affected by gullies only and, according to ACED, this implies that without gullies there could have been no soil loss (Herweg, 1996). In contrast, SLEMSA and RUSLE indicate that, although there are no visible features of erosion, soil loss by interrill erosion does occur. High soil losses predicted by SLEMSA and RUSLE could be attributed to the combination of steep slopes, poor vegetation cover and shallow soils. Although damage by interrill erosion may not be immediately visible, effects such as the decline in soil productivity and soil fertility can be experienced over a long period. However, once the rills and gullies are initiated, the expected damage particularly on fragile soils might be even greater (Laker, 2000; Hudson, 1987).

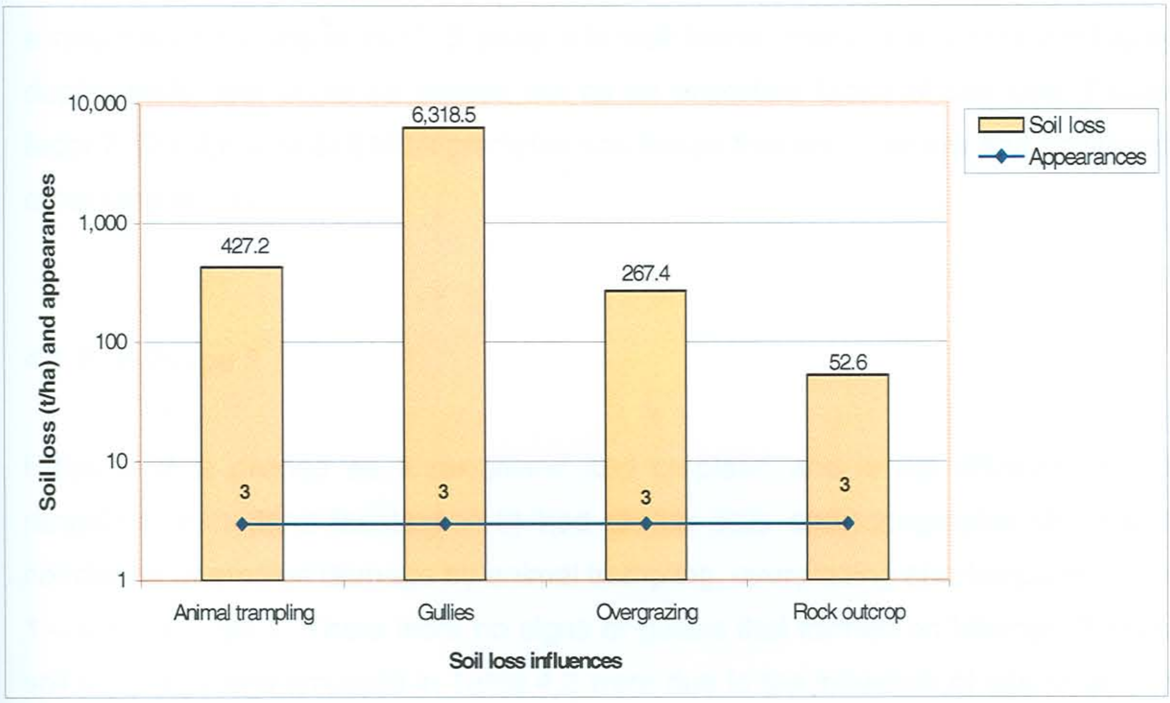

Figure 4.1. Soil loss and appearances of the soil loss influences of hillslope 1 according to ACED method

Gullies, animals trampling and overgrazing were found to be erosion influences responsible for higher soil loss on the rangeland of hillslope 1 (Figure 4.1.). The erosion influences expose the soil surface to soil detachment by interrill and rill erosion processes, and ultimately extensive riling or gulling (Appendix 5, Plate 2).

According DATS (1973), SLEMSA considered most soils on hillslope 1 as having moderate erosion potential (Appendix 4, Table 1(b)). This supported by the soil loss classes (Appendix 3, Table 12) proposed by Bergsma (1986), that SLEMSA rated hillslope 1 as very low to moderately erosion potential, with the exception of very high erosion potential on land facet 7 due to presence of the Escourt soil form (Table 4.1). Therefore, SLEMSA considered Escourt soil as the single most significant contributor of soil loss on the hillslope. Although, RUSLE agrees with SLEMSA that hillslope 1 has low to moderately erosion potential, it does not consider Escourt soil on land facet 7 as major influential factor of soil loss. According to RUSLE model, erodibility should not be isolated from interactions of factors such as cover conditions that can have an impact on soil loss (Renard *et al.,* 1991). This could prove to be a major shortcoming of RUSLE since it is well known that Escourt soils are highly erodible duplex soils, and could be singled out as an important factor of soil loss. Except for land facet 7, RUSLE and SLEMSA predicted soil losses that are quite low and comparable on the other land facets.

4.1.2 Hillslope 2

Hillslope 2 is divided as a rangeland and cropland and is not affected by gullies. The rangeland part (land facets 1 – 6) had similar soils and topographic characteristics and conditions of erosion damage by animal trampling, overgrazing and footpaths as land facets 1 – 6 of hillslope 1. There were no signs of gullies that formed on hillslope 2, therefore, the soil loss rates and amounts in Table 4.2 were due to the influence of interrill and rill erosion. Soil losses on Table 4.2 were obtained from soil loss calculation tables of Appendix 5, hillslope 2.

The ACED method indicated that the higher soil loss and greater damage on the rangeland was due to deep-wide rills which appeared to be more severe and permanent than on the cropland (Table 4.2 and Appendix 4, Table 2(a) and 5). The rangeland had shallow soils, steep gradients and poor vegetation cover (Figure 3.4 and Appendix 3, Table 7.4). The cropland had better conditions that prevented it from excessive erosion damage and soil loss compared to rangeland. Firstly, the small but severe rills on the cropland are often interrupted by the primary tillage practices, therefore, are not permanent as those of the rangeland (Appendix 3, Table 4). Secondly, a drainage furrow on land facet 6 (homestead) above the cropland prevented high velocity runoff from the rangeland of the runon onto the cropland by diverting most of the runoff to hillslope 1 and nearby side gully, (Plate 7, Appendix 5). Thirdly, the cropland cover was improved by intercropping of maize and Canibus sativa that protect it from raindrop impact and soil loss (Plate 9, Appendix 5). Fourthly, Hutton soils on the cropland have low erosion potential (Appendix 4, Table 2(b)). Though, the average slope gradient on the cropland was more than 25%, which is the maximum gradient permissible required for sustainable crop practices (DATS, 1976; Hudson, 1987).

Table 4.2. Soil loss as predicted by SLEMSA and RUSLE and measured by ACED for the land facets of hillslope 2

Land facet no.	**Field Size** (m^2)	**ACED** (t/ha)	**SLEMSA** (t/ha/yr)		**RUSLE** (t/ha/yr)
		Rills only	Elwell and Stocking (1973) approach	Schulze (1979) and Hudson (1980) approach	
1	1020	4.3	84.6	12.6	7.7
2	924	1.2	29.1	4.3	6.8
3	920	320.5	37.3	5.5	17.8
4	1452	54.7	70.3	10.4	17.1
5	2080	9.0	35.9	5.3	15.1
6	3040	0.0	390.3	49.2	70.4
7	630	1.0	29.6	5.8	24.2
8	630	0.8	80.7	16.0	26.4
9	980	0.1	43.9	8.7	28.6
10	385	21.6	19.9	3.9	17.1
11	420	8.8	36.1	7.1	22
12	715	2.3	16.9	3.3	16.0
13	320	0.2	8.3	1.6	1.0
Total	**13516**	**424.6**	-	-	-

The weakness of ACED was shown on land facet 6 of hillslope 2, whereby the absence of rills or visible damage was translated as zero soil loss (Herweg, 1996). The referred land facet is almost a bare homestead (Appendix 3, Table 4), and thus, susceptible to interrill erosion as shown by SLEMSA and RUSLE (Morgan, 1995). SLEMSA indicate topography and the inherent soil's erodibility as the influential factors as shown on land facet 1 and 4 (Appendix 3, Table 3). Interestingly, RUSLE showed higher soil loss values on most of the land facets than SLEMSA due to the absence of poor canopy and ground cover. It seems that RUSLE, though it considers the interaction of other erosion factors, singled out vegetation as the most important factor of soil loss. Also, RUSLE is very sensitive to vegetation cover.

According to Figure 4.2, ACED indicated that the rock outcrop was the most influential factor on the hillslope contributing to the higher soil loss. But, a bare soil or little vegetation maintenance contributed a higher soil loss compared to other land management practices.

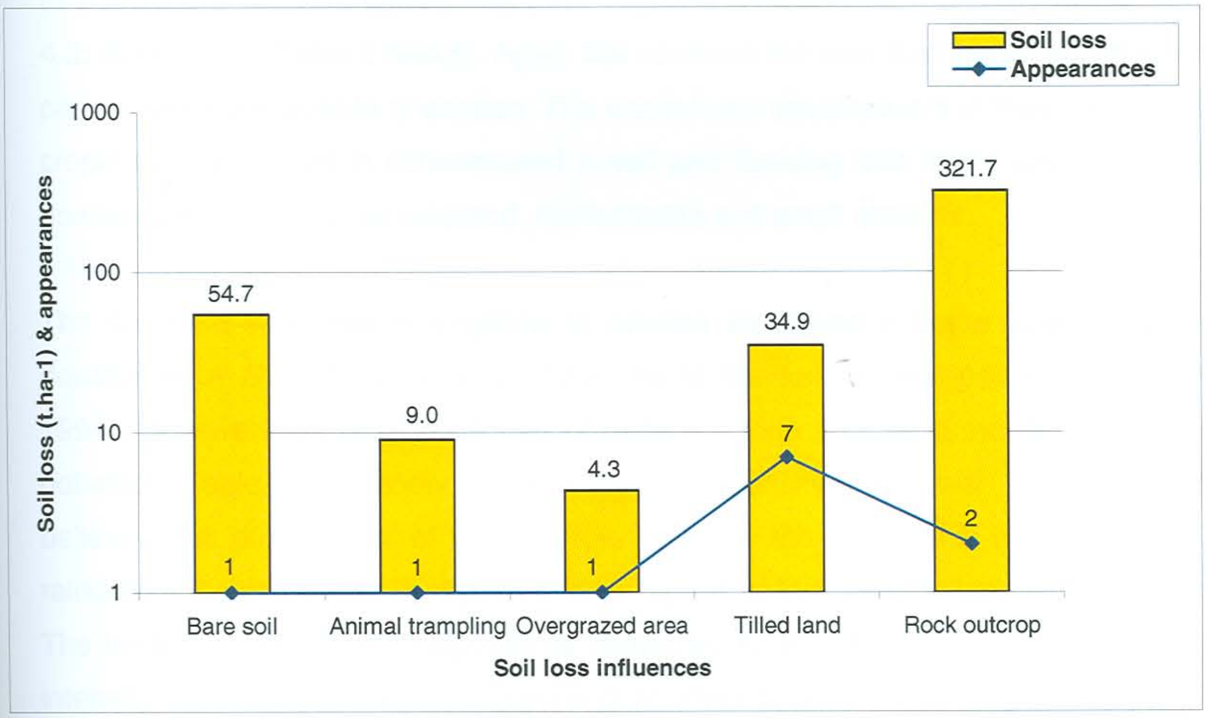

Figure 4.2. Soil loss and appearances of the soil loss influences of hillslope 2 according to ACED method

4.1.3 Hillslope 3

Hillslope 3 was divided into a rangeland (land facet 1 – 7) and cropland (land facets 8 – 14) (Figure 3.5). The rangeland has less steep gradients and poor vegetation cover as compared to hillslope 1 and 2. The shallow clayey and medium textured soils (Appendix 3,

Table 5) on the rangeland have low to medium erosion susceptibility (DATS, 1973). It was utilised for communal grazing and is exposed to similar influences and the rangeland of hillslope 1 and 2 (Appendix 3, Table 6). According to SLEMSA, the Shortland soil form on land facets 6 and 7 has low erosion potential (DATS, 1973). However, land facet 6 and 7 were affected by a gully and deep-wide rills, thereby resulting in higher soil loss amounts as shown by ACED (Table 4.3; Appendix 4, Table 5). In general, the rangeland experiences moderately high runoff potential and low infiltration (Appendix 3, Table 5 and 6). ACED indicated and SLEMSA predicted that considerable soil loss occurred on the rangeland due to permanent rills and gullies and poor vegetation cover and erodibility of the soils (Table 4.3; Appendix 3, Table 5 and 6). Again this confirms the view that the unprotected rangeland can be more susceptible to erosion. The unhindered development of these gullies above the cropland could result in concentrated runoff and flooding that might cause damage to the downslope areas such as cropland, homesteads and small streams.

The cropland was less susceptible to erosion as it had a better canopy cover and is dominated by Clovelly soils, which have low to medium erosion potential (Haarhoff *et al.,* 1994). However, SLEMSA considers Clovelly soil form as having moderate to high erosion potential (Table 3, Appendix 4). Although, rill intensity was lower on the cropland, it is believed that during most of the rainy period when the cropland is barely covered againts raindrop impact, soil loss is expected to be higher as indicated on land facet 6 of hillslope 2. The lower soil loss of the cropland as shown by ACED (Table 4.3) was a result of low rill intensity due to good cover conditions and an often disturbance by tillage practices.

Table 4.3. Soil loss as predicted by SLEMSA and RUSLE and measured by ACED for the land facets of hillslope 3

Land facet no.	**Field Size** (m^2)	**ACED** (t/ha)		**SLEMSA** (t/ha/yr)		**RUSLE** (t/ha/yr)
		Rills and Gullies	Rills only	Elwell and Stocking (1973) approach	Schulze (1979) and Hudson (1980) approach	
1	506	0.0	0.0	4.6	0.7	0.2
2	946	25.4	25.4	18.1	2.7	0.1
3	840	199.0	199.0	37.3	5.5	4.4
4	1296	13.0	13.0	41.5	5.2	4.8
5	1920	166.2	166.2	39.1	5.8	28.6
6	3496	895.8	331.8	21.2	3.5	20.5
7	2584	286.7	286.7	10.8	1.8	14.1
8	4704	0.1	0.1	106.0	7.5	20.9
9	3888	0.0	0.04	24.4	5.0	15.0
10	4896	0.03	0.03	37.4	7.7	11.9
11	4368	0.04	0.04	110.0	38.9	13.2
12	4452	0.01	0.01	98.3	34.7	13.9
13	3648	0.07	0.07	124.8	44.1	11.7
14	4464	0.04	0.04	271.8	110.5	6.4
Total	**42,003**	**1,586.4**	**1,022.4**	-	-	-

Land facet 1 had a better vegetation cover and stable slope gradient and no rills. The only soil loss produced was due to interrill erosion. According to ACED, the absence of rills is assumed to have zero soil loss (Herweg, 1996).

SLEMSA showed a significant soil loss on a relatively flat land facet 14 with good vegetation cover (Appendix 3, Table 5 and 6). The soil loss was expected to be lower since it was more conducive for soil deposition to occur. However, having rated Avalon soil form as high erosion potential (Appendix 4, Table 8), the over-estimation is likely to occur because SLEMSA considers the inherent erodible nature of the soil as the cause. According to DATS (1976), the highly erodible Clovelly and Avalon soils on the cropland should be cultivated. In contrast, RUSLE predicted little erosion to occur due to good vegetation cover and relatively flat land facet. RUSLE predictions showed not much varying trends in the soil loss between cropland and rangeland. In general, all the methods indicated higher soil losses on the rangeland than on the cropland.

Except for the soil's erodibility and steep slopes on the rangeland, higher soil loss could be attributed to and exacerbated by agricultural practices such as communal grazing and animal movements resulting in poor vegetation cover and rill development (Laker, 1990; Maswana, 2001). Figure 4.3 showed that even though animal trampling and bareness of the soil had less appearance compared to other soil loss influences, they contributed most of the soil loss of the hillslope.

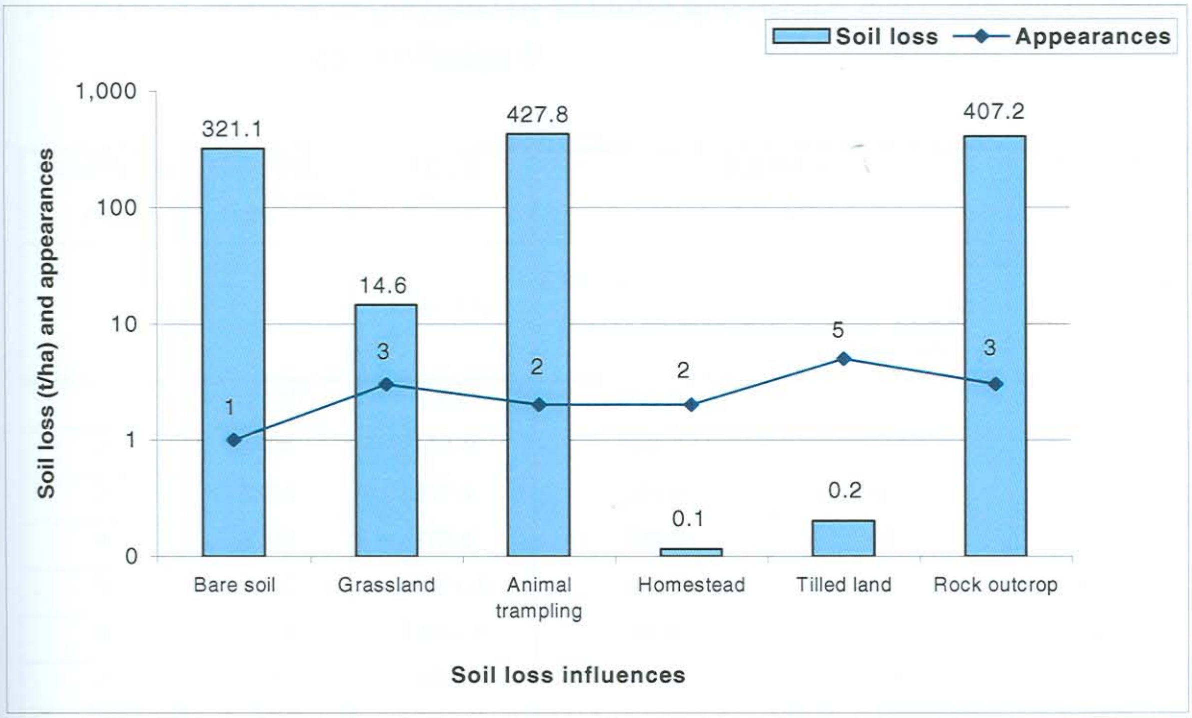

Figure 4.3. Soil loss and appearances of the soil loss influences on hillslope 3 according to ACED method

4.1.4 Hillslope 4

At the time of the study hillslope 4 was utilised as a rangeland with an abandoned cropland on land facet 5 and 6. Hillslope 4 is much flatter and longer than the other hillslopes. It has moderate and high erosion potential soils of the Mispah and Clovelly soil form on the upper rangeland and low erosion potential soils of Griffin soil form at the bottom (Appendix 3, Table 7 and 8; Appendix 4, Table 4(b)). According to Haarhoff *et al.*, (1994), the shallow medium-textured Glenrosa soil form on the upper rangeland have very low infiltration rates whereas the deep medium-textured Griffin on the abandoned land and lower rangeland have moderate infiltration rates (Appendix 3, Table 7). In general, the hillslope has moderate to low runoff potential (Haarhoff *et al.,* 1994).

Table 4.4. Soil loss as predicted by SLEMSA and RUSLE and measured by ACED for the land facets of hillslope 4

Land facet no.	**Field Size** (m^2)	**ACED** (t/ha)	**SLEMSA** (t/ha/yr)		**RUSLE** (t/ha/yr)
		Rills only	Elwell and Stocking (1973) approach	Schulze (1979) and Hudson (1980) approach	
1	12740	0.01	311.9	12.2	1.4
2	5440	109.9	159.2	6.2	15.6
3	5904	257.4	104.5	4.1	4.0
4	3200	373.5	108.2	44.1	5.7
5	5040	6,281.4	119.2	94.6	10.1
6	5760	5,842.1	35.6	15.9	13.4
7	6136	60.7	23.6	0.6	1.8
8	4104	603.8	26.1	0.7	2.0
9	8892	80.8	63.1	1.6	1.9
Total	**57216**	**13,609.7**	-	-	-

According to ACED, hillslope 4 had the highest soil loss amount and was the most affected by extensive rill erosion than any of the selected hillslopes (Table 4.4; Appendix 4, Table 4(a) and 5). On land facet 6 and 7 (abandoned land) all the models and field assessment method showed increased soil loss potential and amount due to extensive damage by wide rills and interrill erosion. The abandoned land could no longer be cultivated and the important topsoil has been eroded away and the subsoil is exposed to the surface (Plates 1 and 2, Appendix 5). This resulted in bush encroachment on the land. The poor vegetation growth is generally related to low nutrient status and crusting of the exposed subsoil that makes it difficult for vegetation to re-establish itself. Although this hillslope has soils that could be classed as high potential agricultural land under various climatic conditions, the fact that its erodibility under the study area climate was so high it should actually be classed as low potential and non-arable (Laker, 1993, 1994).

This network of deep rills was probably caused by the high runoff rate as influenced by the extensiveness of the hillslope length and poor vegetation cover on the unprotected abandoned cultivated land. This led to unhindered deep riling which could lead to development of gullies. Ultimately, gullies on these land facets may cause flooding and pose a serious threat to the low-lying areas.

The relatively higher soil loss estimated by SLEMSA on land facets 1 and 5 could be attributed to the influence of slope length and soil's erodibility. RUSLE estimated higher soil losses on the abandoned land due to poor vegetation cover.

The abandonment of the land on this hillslope could be singled-out as the most influential land management practice that causes higher soil loss (Figure 4.4). Land abandonment due to inappropriate land use and impact of socio-economic conditions can lead to serious land degradation (Laker 1990; Mashali, 2000).

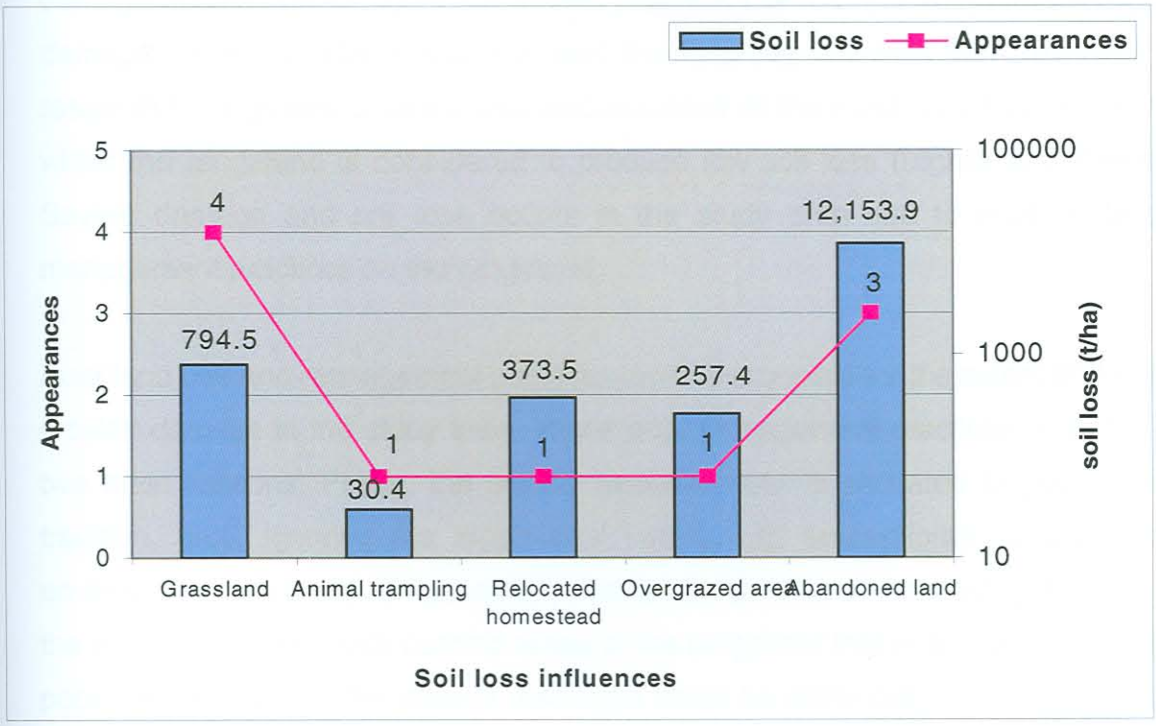

Figure 4.4. Soil loss and appearances of the soil loss influences on hillslope 4 according to ACED method

4.1.5 General discussion

The study area is naturally prone to erosion due to the erosivity of the rainfall, steep topography and erodible nature of the soils. The soil loss results as summarised in Appendix 3, Tables 1 – 12, indicate that the study area is moderately to highly eroded and experience moderate to high runoff potential. The high soil loss that took place in the study area indicated that its agricultural potential becomes limited under the unsustainable land use and management.

The development of gullies and extensive interrill erosion in the area affect the potential land use (Appendix 5, Plate 3; 4 and 7). Although gullies occupy a relatively small area, the magnitude of the damage was great, particularly on the rangeland where most of the damage occurs due to higher soil losses (Table 4.1 and 4.3). Except for hillslope 4, erosion damage on the cropland was low and the resulting soil loss was relatively low. Many research findings would list the cropland practices as the most contributing factor to soil loss whilst the rangeland is considered to produce low soil loss (Highfill and Kimberlin, 1977). Severe damage and soil loss occurs in the study area due to erodible land and poor management practices on the rangeland.

Poor land use and management practices were responsible for the extent of the soil loss and erosion damage in the study area. These poor management practices could be ascribed to two main reasons. Firstly, the limited available land is allocated to people according to tradition, thus, ignoring the biophysical nature and susceptibility to degradation of the environment. Secondly, unsystematic intensively communal livestock grazing is allowed on the steep slopes and rock outcrop areas of the rangeland that is susceptible to erosion. Also, poor management of the natural resources could be attributed to the increased population that have to share limited available land. This led to the utilisation of the erodible land for cultivation and grazing on steep slopes due to the socio-economic conditions of the community as indicated by Plate 7, Appendix 5 and Figure 3.4 (Laker, 1994; Ramphele and Mc Dowel, 1991). The lack of available land and socio-economic conditions of the community led to the further deterioration of the communal land due to uncontrolled animal movement and overgrazing.

Furthermore, cultivation of steep slopes and traditional cropping practices have led to increased soil loss and lower crop production. In severe cases, this has led to the abandonment of the land as shown by Figure 4.4. Without erosion conservation measures the areas could become useless as shown by Plate 1 and 2 (Appendix 5). Maswana (2001) has also emphasised this in a study in the Eastern Cape province of South Africa.

Table 4.5. Simulated soil loss by SLEMSA through improved vegetation and land management practices

Current vegetation and land management practices						Simulated vegetation and land management practices				
Hillslope	**Land facet**	**% Canopy cover**	**c-value**	**Land management practices**	**Soil loss** (t/ha/yr)	**Improved % canopy cover**	**Improved land management practices**	**New c-value**	**Reduced soil loss** (t/ha/yr)	**% Reduced soil loss**
1	1	60	0.05	Overgrazed grassland	12.1	90	No / rotational grazing	0.045	10.9	10
	3	20	0.057	Overgrazed grassland	5.5	50	No / rotational grazing	0.05	4.9	12.2
	4	40	0.057	Overgrazed grassland	10.4	70	No / rotational grazing	0.05	9.2	12.3
	5	60	0.05	Overgrazed grassland	4.7	75	No / rotational grazing	0.05	4.7	0
2	6	5	0.741	Bare surface	49.2	35	Establish grass cover	0.122	8.1	83.5
	8	30	0.09	Mouldboard plough/fallow	16.1	60	No-till practices	0.058	2.5	84.2
	9	55	0.058	Mouldboard plough	8.7	85	No-till practices	0.05	4.4	49.1
	13	30	0.165	Mouldboard plough	1.6	60	No-till practices	0.05	0.2	86.9
3	8	10	0.549	Bare surface	7.5	40	Establish grass cover	0.122	1.7	77.8
	14	65	0.057	Mouldboard plough	110.5	95	No-till practices	0.05	39.2	64.6
4	2	60	0.05	Overgrazed grassland	6.2	90	No / rotational grazing	0.045	5.6	10
	4	40	0.057	Overgrazed grassland	44.1	70	No / rotational grazing	0.05	38.7	12.3
	5	20	0.057	Abandoned	94.8	50	Establish grass cover-fence off	0.05	83.1	12.3
	6	20	0.057	Abandoned	15.9	50	Establish grass cover-fence off	0.05	14	12.3
Average	-	**36.8**	**0.15**	-	-	**66**	-	**0.060**	-	-

Table 4.6. Simulated soil loss by RUSLE through improved vegetation and land management practices

Current vegetation and land management practices							Simulated vegetation and land management practices					
Hillslope	Land facet	Soil loss (t/ha/yr)	% Vegetation cover		C-value	Land management practices	% Improved vegetation		New c-value	Improved land management practices	Reduced soil loss (t/ha/yr)	% Reduced soil loss
			Cc	Cg			Cc	Cg				
1	1	9	60	35	0.016	Overgrazed grassland	90	65	0.002	No / rotational grazing	1.3	68.3
	3	9.9	20	40	0.029	Overgrazed grassland	50	70	0.008	No / rotational grazing	2.9	36.4
	4	17.2	40	25	0.037	Overgrazed grassland	70	55	0.007	No / rotational grazing	3.3	57.7
	5	10.6	60	20	0.030	Overgrazed grassland	75	50	0.003	No / rotational grazing	1.1	76.6
2	6	70.4	5	5	0.204	Bare surface	35	35	0.026	Establish grass cover	8.8	87.5
	8	26.4	30	5	0.182	Mouldboard plough/fallow	60	35	0.01	No-till practices	1.5	94.2
	9	28.6	55	10	0.176	Mouldboard plough	85	40	0.008	No-till practices	1.3	95.5
	13	1	30	5	0.199	Mouldboard plough	60	35	0.023	No-till practices	0.3	70.2
3	8	20.9	10	5	0.152	Bare surface	40	35	0.033	Establish grass cover	4.6	77.9
	14	6.4	65	10	0.158	Mouldboard plough	95	40	0.005	No-till practices	0.2	97.2
4	2	15.6	60	10	0.054	Overgrazed grassland	90	40	0.008	No / rotational grazing	2.2	86.2
	4	5.7	40	20	0.065	Overgrazed grassland	70	50	0.011	No / rotational grazing	1.1	81.5
	5	10.1	20	20	0.107	Abandoned	50	50	0.025	Establish grass cover- fence off	2.2	78.3
	6	13.4	20	25	0.107	Abandoned	50	55	0.017	Establish grass cover- fence off	2.2	84
Average	-	-	**36.8**	**16.8**	**0.116**	-	**66**	**33.8**	**0.025**	-	-	-

Cc = canopy cover, **Gc** = ground cover, **C-value** = vegetation cover index

As a result of using C-value there was no soil loss reduced, though vegetation was improved (Table 4.5, land facet 1 of hillslope 1). In contrast, RUSLE takes into account that the effect of any change in vegetation cover and land management practices does affect soil loss. In fact, RUSLE incorporates all the best practices utilised in a LandCare project to reduce soil loss (Table 4.7). Theoretically, based on the prediction scenario, it could be concluded that RUSLE is the more preferred model for predicting the effects of the changes in vegetation cover and land management practices. Furthermore, SLEMSA has not been applied for rangeland conditions which, in this case, are affected extensively by gully and rill erosion. Therefore, RUSLE could be a preferred erosion evaluation tool than SLEMSA for the monitoring and evaluation of soil loss in LandCare projects. Given the fact that RUSLE also under-estimate soil loss by ignoring common known erodible soils such as Escourt soil form, it cannot be concluded that it is a better tool than SLEMSA. Furthermore, RUSLE also single out vegetation as the most important factor in the interaction with other erosion factors. This seems to make RUSLE sensitive to changes in vegetation. It is, therefore, recommended that the reliability of SLEMSA and RUSLE should be verified with measured data from the erosion plots.

Though, SLEMSA remains a relatively simple model to use and require less inputs, particularly in southern Africa where most of the data is available, its performance in many areas could be affected by its sensitivity to rainfall and topography (Schulze, 1979; Smith *et al.,* 1997). The reasons for the shortcoming of SLEMSA is that it has not been applied on steep gradients such as that of this study area and it has only been applied successfully with slopes up to 25%. Hudson (1987) and Schulze (1979) have found that scale of application and higher altitudes or steep terrain has a big effect on the kinetic energy of the rainfall that influences the performance of SLEMSA. The E-values (kinetic energy values) from flatter areas or standard agricultural plots could be different from higher altitude and steep areas due to high variation in rainfall. Therefore, contrary to the E-values used in Zimbabwe by Elwell and Stocking (1973) and in Natal by DATS (1976), the E-values should be approached with caution in higher altitude (Schulze, 1979). Furthermore, few improvements have been done on the SLEMSA model. Hudson (1987) proposed the use of MAP (Mean Annual Precipitation) regression equations, such as applied at NTABAMHLOPHE T23, to derive mean annual E value from local rainfall data.

The MAP equation at NTABAMHLOPHE T23 rainfall station is represented as follows:

$$E = 15{,}16\ MAP - 1\ 517{,}67$$

The use of MAP at local scale might be the most precise and reliable method of quantifying soil loss instead of applying mass-produced and thereby reducing sensitivity of SLEMSA to rainfall energy. However, this equation cannot be extrapolated outside their key study areas of Drakensberg. This identifies a shortcoming of SLEMSA since its use by DATS (1976), Schulze (1979) and Hudson (1987) in South Africa.

Based on the advantages and disadvantages of each method applied to select the best practices in LandCare projects (Section 3.6), it was illustrated that ACED could not comply with the requirements for the LandCare practices. For instance, ACED cannot predict soil loss where there was no damage as illustrated in Table 4.1, 4.2 and 4.3. ACED is only applicable where there is visible erosion features such as rills and gullies. SLEMSA and RUSLE are more powerful in that they can evaluate soil loss by estimating it from present conditions and can use data emanating from LandCare project to evaluate the changes in long-term soil loss. Therefore, they can be applied to select the best practices to be implemented by the community in combating land degradation through water erosion. Both SLEMSA and RUSLE do not simulate soil loss processes, therefore, their results should be regarded as ratings to indicate areas of high and low erosion potential (DATS, 1976). Theoretically, RUSLE is a preferred erosion evaluation tool for decision-making than SLEMSA as it predicts soil loss by utilising the best practices in LandCare project.

SLEMSA and RUSLE were able to use available data emanating from LandCare projects to predict changes in the long-term soil loss due to changes in land management practices at farm level. Theoretically, they are suitable tools to monitor and evaluate soil loss due to these practices, to assess areas of high and low erosion potential and for decision-making in LandCare projects. The suitability at present relies on the data required apply the models. With RUSLE, it is possible to incorporate more scenarios of the land management practices that can be modified or linked together to predict soil loss. Therefore, it can be applied to select better combinations of land management practices for use in LandCare. The outcome of SLEMSA was that it does not predict or respond to various land management practices as compared to RUSLE. The fact that RUSLE was more flexible to apply with various land management practices than SLEMSA makes it the preferred model to be applied as a tool for monitoring and evaluation in LandCare projects.

However, RUSLE has shortcomings such that it overlooks the erodibility of the Escourt soil form commonly known to be erodible. Therefore, reliability of the predicted soil losses by both the models applying land use and management practices needs to be verified with with measured data from erosion plots before reliable predictions can be made.

The application of soil loss models such as RUSLE in LandCare projects would be of great importance for three reasons:

1. To benefit research and technology development;
2. To improve community-based natural resources management; and
3. To provide a framework for sustainable developments in environment and integrated land use policies.

If the application of soil loss models in LandCare could be successful, the application of the process-based models such as the WEPP model, which allows erosion to be more holistically predicted, should be investigated in future. Nonetheless, the complexity and impact of data requirements of these models makes them not readily available for application in community-based resource management projects such as LandCare. However, it is also noted that the use of the soil loss models in future should consider local variations of climate, soils and management.

Food security and rural livelihoods in the study area can be improved by improving land management practices that are compatible with good agricultural practices of the community thereby reducing the risk of erosion and land degradation.